REMARKS

It is respectfully submitted that the captioned application is now in condition for examination on its merits.

Respectfully submitted,

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ORTHOGONAL COMPLEX SPREADING METHOD AND APPARATUS

FOR ~~A MULTICHANNEL~~ MULTIPLE CHANNELS

~~AND APPARATUS THEREOF~~

BACKGROUND OF THE INVENTION

1. ~~1.~~ Field of the Invention

The present invention relates to an ~~orthogonal complex spreading method for a multichannel and an apparatus thereof, and in particular, to an~~ improved orthogonal complex spreading method and apparatus for ~~a multichannel~~ multiple ~~multuple~~ channels ~~and an apparatus thereof~~. The invention is ~~which are~~ capable of the following: decreasing a peak power-to-average power ratio by introducing an orthogonal complex spreading structure and spreading ~~the same~~ input signals using a spreading code~~,~~; implementing a structure capable of spreading complex output signals using a spreading code by adapting a permuted ~~permutated~~ orthogonal complex spreading structure for a complex-type multi-channel input signal with respect to the summed values~~,~~; and decreasing a phase dependency of an interference based on a multipath component (when there is an one chip difference) of a self signal, which is a problem that is not overcome by a permuted ~~permutated~~ complex spreading modulation method, nor by a combination of an orthogonal Hadamard sequence.

2. ~~2.~~ Description of the ~~Conventional~~ Prior Art

~~Generally, i~~In the area of mobile communication systems, it is well known in the art

that ~~a~~ linear ~~distortion~~ and non-linear distortions affect power amplifiers. The statistical characteristic of a peak power-to-average power ratio has a predetermined interrelationship for~~-a~~ non-linear distortion.

The third order non-linear distortion, which is one of the factors affecting the power amplifier, causes an inter-modulation ~~product~~ problem in an adjacent frequency channel. The ~~above-described~~ inter-modulation ~~product~~ problem is ~~generated due~~ created by, ~~to~~ a high peak amplitude, which ~~for thereby~~ increases~~ing~~ ~~an~~ the adjacent channel power (ACP), so that there is a predetermined limit for selecting ~~an~~ the amplifier. In particular, the ~~(~~Code Division Multiple Access~~)~~ (CDMA) system requires a very strict condition with respect to ~~a~~ linearity of a power amplifier. Therefore, the above-described condition is a very important factor.

International Standards

In accordance with ~~IS-~~97 and ~~IS-~~98, the FCC stipulates a condition on the adjacent channel power (ACP). In order to satisfy the above-described condition, ~~a~~ the bias of ~~a~~ the Radio Frequency (RF) power amplifier ~~should~~ has to be limited.

According to the current IMT-2000 system standard recommendation, a plurality of CDMA channels are recommended. In ~~the~~ case ~~that~~ a plurality of channels are provided, the peak power-to-average power ratio is considered ~~as~~ an important factor for ~~thereby~~ increasing the efficiency of the modulation method.

The IMT-2000, which is ~~known as the~~ a third generation mobile communication system, has ~~a great~~ received a lot of attention ~~from people~~ as the next generation communication system following the digital cellular system, personal communication system, and etc. The IMT-2000 will be commercially available as a ~~one of the next generation~~ wireless communication system, which has a high capacity and ~~better~~ performance for ~~thereby~~ ~~introducing~~ supporting various multimedia services and

international ~~loaming~~ roaming services, etc.

Many countries have proposed utilizing ~~various~~ IMT-2000 systems ~~which~~ that would require high data transmission rates ~~adapted~~ for ~~an~~ internet service or ~~an~~ electronic commercial activity. This is directly related to the power efficiency of a RF amplifier.

The ~~CDMA-based~~ IMT-2000 ~~system~~ modulation method based on CDMA technology ~~introduced by many countries~~ is classified ~~into~~ as a pilot channel ~~method~~ and ~~a pilot~~ symbol method. ~~Of which,~~ ~~t~~The ~~former~~ pilot channel method is directed to ~~the ETRI 1.0 version introduced in Korea and is directed to~~ the CDMA ONE introduced in North America~~, and~~. ~~t~~The ~~latter~~ pilot symbol method is directed to the NTT-DOCOMO and ARIB proposal introduced in Japan and ~~is directed~~ to the FMA2 proposal ~~in a reverse direction~~ introduced in Europe.

~~Since tThe pilot symbol method, which has a single channel effect based on the power efficiency, it is superior compared to the pilot channel method, which is a multichannel method. However, since the accuracy of the channel estimation is determined by the power control, the above description does not have its any logical ground.~~

Figure 1 illustrates a ~~conventional~~ prior art complex spreading method based on a CDMA ONE method.

The CDMA ONE is implemented by using a complex spreading method. The pilot channel and the fundamental channel spread by a Walsh code 1 are summed thereby forming in-phase information. The supplemental channel spread by a Walsh code 2 and the control channel spread by a ~~Wash~~ Walsh code 3 are also summed thereby forming quadrature-phase information. In addition, the in-phase and quadrature-phase information are complex-spread by PN codes.

As shown ~~therein~~, the signals from a fundamental channel 1A, a supplemental

channel 1B, and a control channel 1C are multiplied by ~~a~~ Walsh codes $W_{4,1}$, $W_{4,2}$ and $W_{4,3}$, which is performed by each multiplier (20A, 20B and 20C) of ~~a~~ multiplication unit 20 through a signal~~-~~mapping unit 10. ~~The signals, which are multiplied by a pilot signal and the Walsh signal, and are then spread are and multiplied by channel gains A0, A1, A2 and A3 by a channel gain multiplication unit 30~~ The pilot ~~singal~~ signal and the signals multiplied by the Walsh codes are respectively multiplied by channel gains A0, A1, A2 and A3 in channel gain multiplication unit 30.

In a summing unit 40, the pilot signal ~~is multiplied by the channel gain A0~~ and the fundamental channel signal~~, which is multiplied by the channel gain A1,~~ are summed by a first adder 40a ~~for~~ thereby obtaining ~~an identical phase~~ in-phase information~~,~~. ~~and~~ Additionally, the supplemental channel signal ~~is multiplied by the channel gain A2~~ -and the control channel signal ~~is multiplied by the channel gain A3~~ and are summed by a second adder 40b ~~for~~ thereby obtaining ~~an orthogonal phase~~ quadrature phase -information.

The ~~thusly obtained~~ in-phase ~~information~~ and quadrature-phase information are then multiplied by ~~a~~ PN1 ~~code~~ and PN2 code by ~~a~~ spreading unit 50.~~,~~ ~~and t~~The identical phase information multiplied by the PN2 code is then subtracted ~~from~~ by the ~~identical phase~~ in-phase information multiplied by the PN~~1~~2 code ~~and~~ is outputted as an I channel signal~~,~~. ~~and t~~The quadrature-phase information multiplied by the PN1 code and the in-phase information

multiplied by the PN2 code are ~~then~~ summed and ~~are~~ then outputted through as a Q channel signal a delay unit 60 ~~such as a Q channel signal~~.

~~The CDMA ONE is implemented by using a complex spreading method. The pilot channel and the fundamental channel spread to a Walsh code 1 are summed for thereby~~

~~forming an in-phase information., and t~~The ~~supplemental channel spread to the Walsh code 2 and the control channel spread to a Walsh code 3 are~~ also ~~summed for thereby forming an quadrature-phase information. In addition, the in-phase information and quadrature-phase information are complex-spread by PN codes.~~

Fig~~ure~~ 2A is a view illustrating a constellation of signals in a phase domain before pluse shaping in a ~~conventional~~ prior art CDMA ONE method~~,~~ and Figure 2B is a view illustrating a constellation of signals in a phase domain after shaping in prior art CDMA ONE method ~~a prior art maximum eye-opening point after the actual shaping filter of Figure 2A.~~

~~As shown therein, i~~In the CDMA ONE, the left and right information, namely, the in-phase information (I channel) and the upper and lower information, namely, the quadrature-phase information (Q channel) pass through the actual pulse shaping filter ~~for~~ thereby causing a peak power~~, and in the ETRI version 1.0, which is shown in Figures 3A and 3B, a peak power may occur in the transverse direction for thereby causing deterioration~~.

In view of the crest factor and the statistical distribution of the power amplitude, ~~in the CDMA ONE,~~ the peak power is generated in a vertical direction~~,~~ so that ~~the~~ problems such as irregularit~~y~~ ~~problem of~~ ~~the~~ spreading code and ~~an~~ ~~inter-interference~~ ~~problem~~ crosstalk occur.

SUMMARY OF THE INVENTION

Accordingly, it is an object of the present invention to provide an orthogonal complex spreading method and apparatus for ~~a multichannel~~ multiple channels ~~and an~~

~~apparatus thereof~~ that overcomes the aforementioned problems encountered in the ~~conventional~~ prior art.

The peak power-to-average power ratio is important in IMT-2000 system since ~~T~~the CDMA system requires a strict condition for ~~a~~ linearity of a power amplifier~~, so that because the peak power-to-average power ratio is important.~~ In particular, ~~the characteristic of the IMT-2000 system is determined based on the efficiency of the modulation method, since multiple channels are provided, and the peak power-to-average power ratio is also adapted as an important factor~~ the IMT-2000 system provides multiple channels, which transmit signals simultaneously, and the peak power-to-average power ratio is related to the efficiency of the modulation method.

It is another object of the present invention to provide an orthogonal complex spreading method and apparatus for ~~a multichannel~~ multiple channels ~~and an apparatus thereof,~~ which have an excellent power efficiency compared ~~to~~ with the complex spreading methods introduced ~~introduce~~ in the CDMA-ONE ~~introduced in~~ of ~~U.S.A.~~ the United States and the W-CDMA ~~introduced in Japan and Europe,~~. Additionally, the invention ~~and~~ is capable of resolving a power unbalance problem of an in-phase ~~channel~~ and ~~a~~ quadrature-phase channel as well as the complex spreading method.

It is still another object of the present invention to provide an orthogonal complex spreading method and apparatus for ~~a multichannel~~ multiple channels ~~and an apparatus thereof~~ which is capable of ~~stably~~ maintaining a stable low peak power-to-average power ratio.

Additionally, in ~~It is still another object of~~ the present invention ~~to provide an orthogonal complex spreading method and apparatus for a multichannel and an apparatus~~

~~thereof~~ ~~in which~~ a spreading operation is implemented as follows: ~~by~~ multiplying ~~a~~ predetermined channel data among data of a multichannel by an orthogonal Hadamard sequence and a gain ~~and,~~; multiplying ~~a~~ data of another channel by an orthogonal Hadamard sequence and a gain~~,~~; summing the information of the two channels in complex type~~,~~; multiplying the summed information of the complex type by the orthogonal Hadamard sequence of the orthogonal type~~,~~; obtaining a complex type~~,~~; summing a plurality of channel information of the complex type in the above-described manner; and multiplying the information of the complex type of the multichannel by a spreading code sequence.

~~It is still another~~Furthermore, it is an object of the present invention ~~to provide an orthogonal complex spreading method and apparatus for a multichannel,~~ ~~and an apparatus thereof which is capable of~~ to decrease~~ing~~ the probability that the power drops to ~~becomes~~ ~~a~~ zero ~~state~~ by doing the following: ~~by~~ preventing the FIR filter input state from exceeding 90° in an earlier sample state~~,~~; increasing the power efficiency and decreasing the consumption of ~~a~~ bias power for a back-off of the power amplifier; and saving the power of a battery.

It is still another object of the present invention to provide an orthogonal complex spreading method and apparatus for a multichannel ~~and an apparatus thereof~~ which is capable of implementing a ~~POCQPSK~~ ~~(~~Permutated Orthogonal Complex QPSK~~)~~ (POCQPSK) which is another modulation method ~~and~~ that has a power efficiency similar with the ~~(OCQPSK)~~ ~~(~~Orthogonal Complex QPSK~~)~~ (OCQPSK).

In order to achieve the above objects, there is ~~provided~~ an orthogonal complex spreading method that is provided for a multichannel which includes the following steps: ~~of~~ complex-summing $\alpha_{n1}W_{M,n1}X_{n1}$, which is obtained by multiplying an orthogonal Hadamard

sequence $W_{M,n1}$ by a first set of data of X_{n1} of a n-th block, and $\alpha_{n2} W_{M,n2} X_{n2}$, which is obtained by multiplying an orthogonal Hadamard sequence $W_{M,n2}$ by a second set of data of X_{n2} of a n-th block; complex-multiplying $\alpha_{n1} W_{M,n1} X_{n1} + j\alpha_{n2} W_{M,n2} X_{n2}$, which is summed in the complex type, and $W_{M,n3} + jW_{M,n4}$ of the complex type using a complex multiplier and outputting ~~as an~~ in-phase ~~information~~ and quadrature-phase information; ~~and~~ summing only in-phase information outputted from a plurality of blocks and only quadrature-phase information outputted therefrom; and spreading the same using a spreading code.

In order to achieve the above objects, there is provided an orthogonal complex spreading apparatus according to a ~~first~~ one embodiment of the present invention which includes the following: a plurality of complex multiplication blocks for distributing the data of the multichannel and complex-multiplying $\alpha_{n1} W_{M,n1} X_{n1} + j\alpha_{n2} W_{M,n2} X_{n2}$ in which $\alpha_{n1} W_{M,n1} X_{n1}$ ~~which~~ is obtained by multiplying the orthogonal Hadamard sequence $W_{M,n1}$ with the first set of data of X_{n1} of the n-th block and the gain α_{n1} and $\alpha_{n2} W_{M,n2} X_{n2}$, which is obtained by multiplying the orthogonal Hadamard sequence $W_{M,n2}$ with the second set of data of X_{n2} of the n-th block and the gain α_{n2} and $W_{M,n3} + W_{M,n4}$ using the complex multiplier; a summing unit for summing only the in-phase information outputted from each block of the plurality of the complex multiplication blocks and summing only the quadrature-phase information; and a spreading unit for multiplying the in-phase ~~information~~ and ~~the~~ quadrature-phase information summed by the summing unit with the spreading code and outputting an I channel and a Q channel.

In order to achieve the above objects, there is provided an orthogonal complex spreading apparatus according to ~~a second~~ another embodiment of the present invention, which includes the following: first and second Hadamard sequence multipliers for allocating the multichannel to a predetermined number of channels, splitting the same into two groups and

outputting $\alpha_{n1}W_{M,n1}X_{n1}$, which is obtained by multiplying the data X_{n1} of each channel by the gain α_{n1} and the orthogonal Hadamard sequence $W_{M,n1}$; a first adder for outputting $\sum_{n=1}^{K}(\alpha_{n1}W_{M,n1}X_{n1})$, which is obtained by summing the output signals from the first Hadamard sequence multiplier; a second adder for outputting $\sum_{n=1}^{K}(\alpha_{n2}W_{M,n2}X_{n2})$, which is obtained by summing the output signals from the second Hadamard sequence multiplier; a complex multiplier for receiving the output signal from the first ~~adder and~~ ~~the output signal from the~~ second adder in the complex form of $\sum_{n=1}^{K}(\alpha_{n1}W_{M,n1}X_{n1}+j\alpha_{n2}W_{M,n2}X_{n2})$ and complex-multiplying $W_{M,I}+jPW_{M,Q}$ ~~which~~ where n=1 consists of the orthogonal Hadamard code $W_{M,I}$ and the ~~permutated~~ permuted orthogonal Hadamard code $PW_{M,Q}$ ~~that~~ where $W_{M,Q}$ and a predetermined sequence P are complex-multiplied; a spreading unit for multiplying the output signal from the complex multiplier by the spreading code; a filter for filtering the output signal from the spreading unit; and a modulator for multiplying and modulating the modulation carrier wave, summing the in-phase ~~signal~~ and ~~the~~ quadrature-phase signal and outputting a modulation signal of the real number.

Additional advantages, objects and other features of the invention will be set forth ~~in part~~ in the description which follows and ~~in part~~ will become apparent to those having ordinary skill in the art upon examination of the following or may be learned from practice of the invention. ~~The objects and advantages of the invention may be realized and attained as particularly pointed out in the appended claims.~~

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will become more fully understood from the detailed

description given ~~herein~~below and the accompanying drawings, which are given by way of illustration only, and thus are not limitative of the present invention, and wherein:

Fig.~~ure~~ 1 is a block diagram illustrating a ~~conventional~~ prior art multichannel complex spreading method of a CDMA ~~(Code Division Multiple Access)~~ ONE method;

Fig.~~ure~~ 2A is a view illustrating a constellation ~~plot~~ of signals in a phase domain before pulse shaping in a ~~conventional~~ prior art CDMA ONE method;

Fig.~~ure~~ 2B is a view illustrating ~~a prior art maximum open point after the actual shaping filter of Figure 2A~~ a constellation of signals in a phase domain after pulse shaping in a prior art CDMA ONE method;

~~Fig.ure 3A is a view illustrating a constellation plot of signals in a phase domain before pulse shaping in a conventional another prior art ETRI version 1.0 method~~;

~~Fig.ure 3B is a view illustrating constellation of a prior art maximum open point after the actual pulse shaping filter of Figure 3A a constellation of signals in a phase domain after pulse shaping in a prior art CDMA ONE method;~~ .

Fig.~~ure~~ 4 is a block diagram illustrating a multi-channel orthogonal complex spreading apparatus ~~according to~~ in accordance with ~~the~~ one ~~a first~~ embodiment of the present invention;

Fig.~~ure~~ 5A is a circuit diagram illustrating the complex ~~multiplexor~~ multiplier of Fig.~~ure~~ 4;

Fig.~~ure~~ 5B is a circuit diagram illustrating the summing unit and spreading unit of Fig.~~ure~~ 4;

Fig.~~ure~~ 5C is a circuit diagram illustrating another embodiment of the spreading unit of Fig.~~ure~~ 4;

Fig.~~ure~~ 5D is a circuit diagram illustrating ~~of~~ the filter and modulator of Fig.~~ure~~ 4;

Fig.~~ure~~ 6A is a view illustrating a constellation ~~plot~~ of signals in a phase domain before pulse shaping in an OCQPSK according to the present invention;

Fig.~~ure~~ 6B is a view illustrating a ~~maximum open point after the actual pulse shaping filter of Figure 6A~~ a constellation of signals in a phase domain after pulse shaping in an OCQPSK in accordance with the present invention;

Fig.~~ure~~ 7 is a view illustrating a ~~power peak occurrence~~ statistical distribution characteristic of power peak occurrences with respect to an average power between the ~~conventional~~ prior art and the present invention;

Fig.~~ure~~ 8 ~~is a view illustrating~~ illustrates an example of an orthogonal Hadamard sequence ~~according to~~ in accordance with the present invention;

Fig.~~ure~~ 9 is a circuit diagram illustrating a multichannel ~~permutated~~ permuted orthogonal complex spreading apparatus ~~according to~~ in accordance with ~~a second~~ another embodiment of the present invention;

Fig.~~ure~~ 10 is a circuit diagram illustrating the complex multiplier ~~according to the present invention~~ of Fig. 8;

Fig.~~ure~~ 11 is a circuit diagram illustrating a multichannel ~~permutated~~ permuted orthogonal complex spreading apparatus ~~for a voice service according to~~ with two input channels in accordance with the present invention;

Fig.~~ure~~ 12 is a circuit diagram illustrating a multichannel ~~permutated~~ permuted orthogonal complex spreading apparatus ~~having a high quality voice service and a low transmission rate according to~~ with three input channels in accordance with the present invention;

Fig.~~ure~~ 13A is a circuit diagram illustrating a multichannel ~~permutated~~ permuted orthogonal complex spreading apparatus for a QPSK having a high transmission rate ~~according to~~ the present invention;

Fig~~ure~~ 13B is a circuit diagram illustrating a multichannel permuted ~~permutated~~ orthogonal complex spreading apparatus ~~for a data having a high transmission rate according to~~ with four input channels in accordance with the present invention;

Fig~~ure~~ 14A is a circuit diagram illustrating a multichannel permuted ~~permutated~~ orthogonal complex spreading apparatus for a multimedia service ~~having a QPSK data according to~~ in accordance with the present invention;

Fig~~ure~~ 14B is a circuit diagram illustrating a multichannel ~~permutated~~ orthogonal complex spreading apparatus ~~for a multimedia service according to~~ with five input channels in accordance with the present invention;

Fig~~ure~~ 15A is a phase trajectory view of an OCQPSK according to the present invention;

Fig~~ure~~ 15B is a phase trajectory view of a POCQPSK according to the present invention; and

Fig~~ure~~ 15C is a phase trajectory view of a prior art complex spreading method ~~according to the present invention~~.

DETAILED DESCRIPTION OF THE INVENTION

The complex summing unit and complex multiplier, according to the present invention, will be explained with reference to the accompanying drawings. In the present

invention, assuming that two complex number ~~two complexes~~ (a+jb) and (c+jd) are used, where a, b, c and d represent predetermined real numbers~~.~~,

~~A~~ a complex summing unit outputs (a+c)+j(b+d)~~,~~ and a complex multiplier outputs

((axc)-(bxd))+j((bxc)+(axd)). ~~Here~~ The following items are defined for the invention:~~,~~ a spreading code sequence is defined as SC~~,~~; ~~an~~ information data is defined as X_{n1}~~,~~ and X_{n2}~~,~~; a gain constant is defined as α_{n1} and α_{n2}~~,~~; and an orthogonal Hadamard sequence is defined as $W_{M,n1}$, $W_{M,n2}$, $W_{M,n3}$, $W_{M,n4}$, $W_{M,I}$, $W_{M,Q}$, where M represents a MxM Hadamard matrix~~,~~ and n1, n2, n3 and n4 represents an index of a predetermined vectors of the Hadamard matrix. For example, n3 represents a Hadamard vector, ~~which~~ wherein $W_{M,n3}$ is a third vector value ~~written into~~ described in the n-th block ~~like the n-th block~~ 100n ~~of~~ shown in Fig.~~ure~~ 4. ~~The Hadamard M represents a Hadamard matrix. For example, if the matrix W has values of 1 and -1, in the W^TxW, the main diagonal terms are M, and the remaining products are zero. Here, T represents a transpose.~~

The data X_{n1}, X_{n2}, $W_{M,n1}$, $W_{M,n2}$, $W_{M,n3}$, $W_{M,n4}$, $W_{M,I}$, ~~and~~ $W_{M,Q}$~~,~~ and spreading ~~code~~ sequence (SC) are combined data consisting of +1 or -1.~~,~~ ~~Real numbers are represented by and~~ α_{n1}~~,~~ and α_{n2} ~~represent real number.~~ are real numbers.

Fig.~~ure~~ 4 is a block diagram illustrating a multichannel orthogonal complex spreading apparatus, ~~according to~~ in accordance with ~~the~~ ~~a first~~ one embodiment of the present invention.

As shown therein, there is provided a plurality of complex multipliers 100 through 100n. ~~in which~~ In a complex multiplier 100n, a data X_{n1} of a predetermined channel is multiplied by a gain α_{n1} and an orthogonal Hadamard sequence $W_{M,n1}$~~,~~ and a data X_{n2} of another channel is multiplied by a gain α_{n2} ~~the~~ and an orthogonal Hadamard sequence $W_{M,n2}$ ~~for thereby complex-summing two channel data.~~, The data from both channels are complex-summed and then t~~The~~ the complex orthogonal Hadamard sequence $W_{M,n3} + jW_{M,n4}$ ~~of the complex type~~ is multiplied ~~by~~ ~~to~~ by the complex-summed data $\alpha_{n1}W_{M,n1}X_{n1} + j\alpha_{n2}W_{M,n2}X_{n2}$~~,~~ and the data of the other ~~two channels~~ complex-multipliers are

~~complex-multiplied~~ obtained in the same manner as described above. ~~A~~ The summing unit 200 sums ~~and outputs~~ the output signals from ~~the~~ complex multipliers 100 through 100n. ~~A~~ The spreading unit 300 multiplies the output signal from the summing unit 200 with a predetermined ~~spreading code~~ SC, ~~for~~ thereby spreading the signal. A pulse shaping filter 400 filters the data spread by the spreading unit 300. A modulation wave multiplier 500 multiplies the output signal from the filter 400 with a modulation carrier wave $e^{2\pi fct}$ ~~and outputs the modulated data through an antenna.~~

As shown in Fig. ~~ure~~ 4, the first complex multiplier 100 complex-sums $\alpha_{11}W_{M,11}X_{11}$, ~~which is~~ obtained by multiplying the orthogonal Hadamard sequence $W_{M,11}$ with the data X_{11} of one channel and the gain α_{11}, and $\alpha_{12}W_{M,12}X_{12}$, ~~which is~~ obtained by multiplying the orthogonal Hadamard sequence $W_{M,12}$ with the data X_{12} of another channel and the gain α_{12}. ~~and Then complex-multiplyingies~~ The $\alpha_{11}W_{M,11}X_{11} + j\alpha_{12}W_{M,12}X_{12}$ ~~and~~ is then multiplied by the complex-type orthogonal sequence $W_{M,13}X_{11}+jW_{M,14}$ ~~using~~ at the complex multiplier 111.

In addition, the n-th complex multiplier 100n complex-sums $\alpha_{n1}W_{M,n1}X_{n1}$, ~~which is~~ obtained by multiplying the orthogonal Hadamard sequence $W_{M,n1}$ with the data X_{n1} of another channel and the gain α_{n1}, and $\alpha_{n2}W_{M,n2}X_{n2}$, ~~which is~~ obtained by multiplying the orthogonal Hadamard sequence $W_{M,n2}$ with the data X_{n2} of another channel and the gain α_{n2}. ~~and~~ ~~Then~~ The ~~complex-multiplyingies~~ $\alpha_{n1}W_{M,n1}X_{n1} + j\alpha_{n2}W_{M,n2}X_{n2}$ ~~and~~ is complex-multiplied by the complex-type orthogonal sequence $W_{M,n3}X_{11}+jW_{M,n4}$ ~~using~~ at the complex multiplier 100n.

The complex multiplication data outputted from the n-number of the complex multipliers are summed at ~~by~~ the summing unit 200, and the spreading code SC is multiplied and spread by using the spreading unit 300. The ~~thusly~~ spread data ~~are~~ is filtered at ~~by~~ the

pulse shaping filter 600~~,~~ and then multiplied by the modulation carried $e^{j2\pi fct}$ ~~is multiplied by~~ at the multiplier 700.~~, and~~ ~~tThen~~ The modulated signal is then processed by the function Re{*} 70 ~~is processed, and~~ to thereby output the real data s(t) 80 ~~is outputted~~ through the antenna. Here, Re{*} 70 represents ~~that~~ a function through which a predetermined complex number is processed ~~to~~ as a real value ~~through the Re{*} 70 function~~.

The above-described function will be explained as follows:

$$\left(\sum_{n=1}^{K}((\alpha_{n1}W_{M,n1}X_{n1} + j\alpha_{n2}W_{M,n2}X_{n2})\overset{\times}{\cancel{\oplus}}(W_{M,n3} + jW_{M,n4}))\right)\overset{\times}{\cancel{\oplus}}SC$$

~~where~~ K represents a predetermined integer greater than or equal to 1~~,~~; and n represents an integer greater than or equal to 1 and less than K and is identical with ~~each channel number of the multichannel~~ the index of each complex multiplier.

~~Each of the complex multipliers 110 through 100n is identically configured so that two sets of different channel data are complex-multiplied.~~

~~As shown i~~In Fig~~ure~~ 5A, ~~one~~ the complex multiplier includes the following: a first multiplier 101 ~~for multiplying the data X_{11} by the orthogonal Hadamard sequence $W_{M,11}$,~~; a second multiplier 102 ~~for multiplying the input signal from the first multiplier 101 by the gain α_{11},~~; a third multiplier 103 ~~for multiplying the data X_{12} of the other channel by another orthogonal Hadamard sequence $W_{M,12}$,~~; a fourth multiplier 104 ~~for multiplying the output signal from the third multiplier 103 by the gain α_{12},~~; fifth and sixth multipliers 105 and 106 ~~for multiplying the output signals $\alpha_{11}W_{M,11}X_{11}$, from the second multiplier 102, and the output signals $\alpha_{12}W_{M,12}X_{12}$, from the fourth multiplier 102, by the orthogonal Hadamard sequence $W_{M,13}$, respectively,~~; seventh and eighth multipliers 107 and 108 ~~for multiplying the output signal $\alpha_{11}W_{M,11}X_{11}$, from the second multiplier 102, and the output signal $\alpha_{12}W_{M,12}X_{12}$, from the fourth multiplier 102, by the orthogonal Hadamard sequence $W_{M,14}$~~;

~~sequentially,~~; a first adder 109 ~~for summing the output signal (+ac), which is from the fifth multiplier 105, and the output signal (-bd), which is from the eighth multiplier 108, and outputting in-phase information (ac-bd),~~;and a second adder 110 ~~for summing the output signal (bc), which is from the sixth multiplier 106, and the output signal (ad), which is from the seventh multiplier 107, and outputting the quadrature-phase information (bc+ad)~~.

~~Therefore~~, tThe first and second multipliers 101 and 102 multiply the data X_{11} by the orthogonal Hadamard sequence $W_{M,11}$ and the gain α_{11} ~~for~~ thereby obtaining $\alpha_{11}W_{M,11}X_{11}$(=a). In addition, the third and fourth multipliers 103 and 104 multiply the orthogonal Hadamard sequence $W_{M,12}$ and the gain α_{12} ~~for~~ thereby obtaining $\alpha_{12}W_{M,12}X_{12}$(=b). The fifth and sixth multipliers 105 and 106 multiply $\alpha_{11}W_{M,11}X_{11}$(=a) and $\alpha_{12}W_{M,12}X_{12}$(=b) by the orthogonal Hadamard sequence $W_{M,13}$(=c), respectively, for thereby obtaining $\alpha_{11}W_{M,11}X_{11}W_{M,13}$(=ac) and $\alpha_{12}W_{M,12}X_{12}W_{M,13}$(=bc).~~,~~ ~~and~~ Additionally, the fifth and sixth multipliers 105 and 106 multiply $\alpha_{11}W_{M,11}X_{11}$(=a) and $\alpha_{12}W_{M,12}X_{12}$(=b) by the orthogonal Hadamard sequence $W_{M,14}$(=d) ~~for~~ thereby obtaining $\alpha_{11}W_{M,11}X_{11}W_{M,14}$(=ad) and $\alpha_{12}W_{M,12}X_{12}W_{M,14}$(=bd). Thus, $\alpha_{12}W_{M,12}X_{12}W_{M,14}$ is subtracted from $\alpha_{11}W_{M,11}X_{11}W_{M,13}$. ~~In addition,~~ Tthe second adder 110 then computes ($\alpha_{11}W_{M,11}X_{11}W_{M,14}$)+($\alpha_{12}W_{M,12}X_{12}W_{M,13}$) (ad+bc).~~,~~ ~~namely~~ Specifically, $\alpha_{11}W_{M,11}X_{11}W_{M,14}$(=ad) is added with $\alpha_{12}W_{M,12}X_{12}W_{M,13}$(=bc).

Referring back to Fig.~~ure~~ 4, ~~illustrates~~ the first complex multiplier 100~~, which~~ is configured identically with the n-th complex multiplier 100n. The expression "(a+jb)(c+jd) = ac-bd+j(bc+ad)" is obtained assuming that $\alpha_{11}W_{M,11}X_{11}$ is "a", $\alpha_{12}W_{M,12}X_{12}$ is "b", the orthogonal Hadamard sequence $W_{M,13}$ is "c", and the orthogonal Hadamard sequence $W_{M,14}$ is "d"~~, the expression "(a+jb)(c+jd) = ac-bd+j(bc+ad)" is obtained~~. Therefore, the

signal outputted from the first complex multiplier 100 becomes the in-phase information "ac-bd" and the quadrature-phase information "bc+ad".

In addition, Fig~~ure~~ 5B is a circuit diagram illustrating the summing ~~unit~~ and spreading unit of Fig~~ure~~ 4~~,~~ and Fig~~ure~~ 5C is a circuit diagram illustrating another embodiment of the spreading unit of Fig~~ure~~ 4.

As shown therein, the summing unit 200 includes a first summing unit 210 for summing the in-phase information A_1(=(ac-bd))~~, ..., An~~ outputted from a plurality of complex multipliers~~,~~ and a second summing unit 220 for summing the quadrature-phase information B_1(=(bc+ad)) outputted from the complex multipliers.

The spreading unit 300 includes first and second multipliers 301 and 302 for multiplying the output signals from the first adder 210 and the second adder 220 of the summing unit 200 by ~~the spreading sequence~~ the SC~~, respectively~~. ~~Namely,~~ ~~t~~~~The~~ In other words, the in-phase and quadrature-phase signals are ~~then~~ spread by the same ~~to the in-phase signal (I channel signal) and the quadrature-phase signal (Q channel signal) using one spreading code~~ SC.

In ~~addition, as shown in~~ Fig~~ure~~ 5C, the spreading unit 300 includes the following: first and second multipliers 310 and 320 ~~for multiplying the output signals from the first and second adders 210 and 220 of the summing unit 200 by the spreading sequence SC1,~~; third and fourth multipliers 330 and 340 ~~are included for multiplying the output signals from the first and second adders 210 and 220 by a spreading sequence SC2,; respectively,~~; a first adder 350 ~~for summing the output signal (+) from the first multiplier 310 and the output signal (-) from the third multiplier 330 and outputting an I channel signal,~~; and a second ~~summing unit~~ adder 360 ~~for summing the output signal (+) from the second multiplier 320 and the output signal (+) from the fourth multiplier 340 and outputting a Q channel signal~~.

~~Namely,~~ In the summing unit 200, the in-phase ~~information~~ and ~~the~~ quadrature-phase information of the n-number of the complex multipliers are summed by the first and second ~~summing units~~ adders 210 and 220. In the spreading unit 300, the in-phase ~~information summing~~ value (g) and the quadrature phase ~~information summing~~ value (h) from the summing unit 200 are multiplied by the first spreading code SC1 (l) by the first and second multipliers 310 and 320 ~~for~~ thereby obtaining gl and hl. ~~and~~ ~~The~~ in addition, the in-phase ~~information summing~~ value (g) and the quadrature phase ~~information summing~~ value (h) from the summing unit 200 are multiplied by the second spreading code SC2(m) by the third and fourth multipliers 330 and 340 ~~for~~ thereby obtaining gm and hm. ~~and~~ The first adder 350 computes gl-hm, in which hm is subtracted from gl, and the second adder 360 computes hl+gm, in which hl is added by gm.

~~As shown~~ In Figure 5D, the filter 400 includes first and second pulse shaping filters 410 and 420 for filtering the I channel signal, which is the in-phase information shown in Figure 5B and 5C, and the Q channel signal, which is the quadrature phase information signal. The modulation unit 500 includes the following: first and second multipliers 510 and 520 for multiplying the output signals from the first and second pulse shaping filters 410 and 420 by $\cos(2\pi f_c t)$ and $\sin(2\pi f_c t)$; and an adder 530 for summing the output signals from ~~the~~ the first and second multipliers 510 and 520 and outputting a modulation data S(t).

~~Here,~~ In the present invention, the orthogonal Hadamard sequences may be ~~used as~~ replaced by a Walsh code or other orthogonal code.

~~For example, from now on, the case where that the orthogonal Hadamard sequence is used for the 8x8 Hadamard matrix, shown in Figure 8, will be explained.~~ Figure 8 illustrates a 8x8 Hadamard matrix as an example of the Hadamard ~~(or Walsh)~~ code. ~~Namely, the case that~~ The sequence vector of a k-th column or row is set to W_{k-1} ~~based on the 8x8~~

~~Hadamard matrix is shown therein~~. In this case, if k is 1, W_{k-1} represents W_0 of the column or row~~,~~ and if k is 5, W_{k-1} represents W_4 of the column or row.

~~Therefore, i~~In order to enhance the efficiency of the present invention, the orthogonal Hadamard sequence by which ~~multiplies~~ each channel data is multiplied, is determined as follows. In the MxM Hadamard matrix, the sequence vector of the k-th column or row is set to W_{k-1}. ~~Therefore,~~ ~~and~~ It can be set that $W_{M,n1}=W_0, W_{M,n2}=W_{2p}$ (where p represents a predetermined number of (M/2)-1), ~~and~~ $W_{M,n3}=W_{2n-2}, W_{M,n4}=W_{2n-1}$(where n represents the number of n-th blocks)~~, and~~ so that $\alpha_{n1}W_0X_{n1}+j\alpha_{n2}W_{2p}X_{n2}$ is complex-multiplied ~~and~~ by $W_{2n-2}+jW_{2n-1}$.

~~The case that only first complex multiplier is used in the embodiment of Figure 4, namely,~~ In ~~Figure~~ Fig. 4, if only the first complex multipliers are used, ~~in order words~~ then, only the ~~data of~~ two channels are complex-multiplied ~~by a first complex multiplier will be explained. In the MxM (M=8) Hadamard matrix, if the k-th column or row sequence vector is set to W_{k-1}, it is possible to determine~~ so that it can be determined that $W_{M,11}=W_0$, $W_{M,12}=W_2$, or $W_{M,12}=W_4$, ~~and~~ $W_{M,13}=W_0$, and $W_{M,14}=W_1$, so that ~~In addition, it is possible to complex-multiply~~ $\alpha_{11}W_0X_{11}+j\alpha_{12}W_2X_{12}$ or $\alpha_{11}W_0X_{11}+j\alpha_{12}W_4X_{12}$ is complex-multiplied by ~~and~~ W_0+jW_1.

~~In the case that~~ If the two complex multipliers, ~~shown in Figure~~ 4, are used in Fig. 4, ~~the second complex multiplier determines~~ it can be determined that $-W_{M,21}=W_0$, $W_{M,22}=W_4$, ~~and~~ $W_{M,23}=W_2$, and $W_{M,24}=W_3$, so that ~~it is possible to complex-multiply~~ $\alpha_{21}W_0X_{21}+j\alpha_{22}W_4X_{22}$ is complex-multiplied by ~~and~~ W_2+jW_3.

~~In addition, as shown in Figure 5,~~ Additionally, ~~when the~~ if spreading is implemented by using the ~~spreading code~~ SC, as shown in ~~Figure~~ Fig. 5, one spreading code may be used~~,~~. However, ~~and as shown in Figure 5C,~~ two spreading codes SC1 and SC2 may also be used.

as shown in Fig~~ure~~ 5C, ~~for thereby implementing the spreading operation~~.

In order to achieve the objects of the present invention, the ~~orthogonal Hadamard sequence directed to multiplying each channel data may be determined as follows. The~~ combined orthogonal Hadamard sequence may be used instead of the orthogonal Hadamard sequence ~~for~~ thereby removing ~~a predetermined~~ phase dependency based on the interference generated in the multiple paths ~~type~~ of self-signal and the interference ~~generated by~~ other users.

~~For example, in the case of two channels, w~~When the sequence vector of the k-th column or row is set to W_{k-1} in the MxM (M=8) Hadamard matrix, and the sequence vector of the m-th column or row is set to W_m, the combined orthogonal Hadamard vector $W_{k-1//-m-1}$ is constructed by taking the first M/2 or the last M/2 ~~is obtained based on~~ from the vector W_{k-1}, and the last M/2 or the first M/2 ~~is obtained based on~~ from W_{m-1}~~, so that the combined orthogonal Hadamard vector is set to $W_{k-1//m-1}$, and~~ In the case of two channels, for example, it is possible to determine $W_{M,11}=W_0$, $W_{M,12}=W_{4//1}$, $W_{M,I1}=W_0$, $W_{M,Q}=W_{1/4}$ ~~are determined~~, so that ~~it is possible to complex-multiply~~ $\alpha_{11}W_0X_{11}+j\alpha_{12}W_{4//1}X_{12}$ is complex-multiplied ~~and~~ by $W_0+jPW_{1//4}$.

In ~~the~~ case of three channels, ~~the sequence vector of the k-th column or row is set to W_{k-1} based on the MxM (M=8) Hadamard matrix, and the sequence vector of the m-th column or row is set to W_M, so that the first M/2 or the last M/2 is obtained from the vector W_{k-1}, and the last M/2 or the first M/2 is obtained from W_{m-1}, and the combined orthogonal Hadamard vector is set to $W_{k-1//m-1}$, and~~ the summed value of $\alpha_{11}W_0X_{11}+j\alpha_{12}W_{4//1}X_{12}$ and $\alpha_{21}W_2X_{21}$ ~~and $W_0+jPW_{1//4}$~~ are complex-multiplied by $W_0+jPW_{1//4}$ based on $W_{M,11}=W_0$, $W_{M,12}=W_{4//1}$, $W_{M,21}=W_2$, and $W_{M,I}=W_0$, $W_{M,Q}=W_{1//4}$.

In addition, in ~~the~~ the case of two channels, ~~when the sequence vector of the k-th column or row of the MxM (M=8) Hadamard vector matrix is set to W_{k-1}, and the sequence vector of the m-th column or row is set to W_m, the first M/2 or the last M/2 is obtained from the vector W_{k-1}, and the last M/2 or the first M/2 is obtained from W_{m-1}, so that the combined orthogonal Hadamard vector is set to $W_{k-1//m-1}$, and~~ the summed value of $\alpha_{11}W_0X_{11}+j\alpha_{12}W_{2//1}X_{12}$ ~~and $W_0+jPW_{1//2}$~~ are complex-multiplied by $W_0+jPW_{1//2}$ based on $W_{M,11}=W_0$, $W_{M,12}=W_{2//1}$, and $W_{M,I}=W_0$, $W_{M,Q}=W_{1//2}$.

In addition, in the ~~case~~ case of three channels, ~~when the sequence vector of the k-th column or row of the MxM (M=8) Hadamard vector matrix is set to W_{k-1}, and the sequence vector of the m-th column or row is set to W_m, the first M/2 or the last M/2 is obtained from the vector W_{k-1}, and the last M/2 or the first M/2 is obtained from W_{m-1}, so that the combined orthogonal Hadamard vector is set to $W_{k-1//m-1}$, and~~ the summed value of $\alpha_{11}W_0X_{11}+j\alpha_{12}W_{2//1}X_{12}$ and $\alpha_{21}W_4X_{21}$ ~~and $W_0+jPW_{1//2}$~~ are complex-multiplied by $W_0+jPW_{1//2}$ based on $W_{M,11}=W_0$, $W_{M,12}=W_{2//1}$, $W_{M,21}=W_4$, and $W_{M,I}=W_0$, $W_{M,Q}=W_{1//2}$.

~~Here, so far~~ Therefore, the cases of two ~~channels~~ and three channels ~~were~~ have been explained. The ~~cases of~~ two ~~channels~~ and three channels may be selectively used in accordance with the difference of the impulse response characteristic ~~difference~~ of the pulse shaping bandpass filter.

Fig.~~ure~~ 6A is a view illustrating a constellation ~~plot~~ of signals in a phase domain before pulse shaping in the OCQPSK ~~according to~~ in accordance with the present invention~~,~~. Fig.~~ure~~ 6B is a view ~~illustrating a maximum eye-opening point after the actual pulse shaping filter~~ of a constellation of signals in a phase domain after pulse shaping in an OCQPSK of Fig.~~ure~~ 6A~~,~~. ~~and~~ Fig.~~ure~~ 7 is a view illustrating a ~~power peak occurrence~~ statistical distribution characteristic of power peak occurrences with respect to an average power

between ~~the OCQPSK, according to the present invention, and the conventional~~ the prior art CDMA ONE and ~~version ETRI 1.0~~ the present invention. ~~As shown therein, t~~The embodiment of Fig.~~ure~~ 6A is similar to ~~with that of~~ Fig.~~ure~~ 2A. However, there is a difference in ~~the point of~~ the ~~maximum eye-opening point~~ signals after the ~~actual~~ pulse shaping ~~filter~~. ~~Namely, i~~In ~~f~~Fig.~~ure~~ 6B, the range of the upper and lower information (Q channel) and the left and right information (I channel) are ~~fully satisfied~~ saturated to their respective limits. This causes the difference of the statistical distribution of the peak power-to-average power.

Fig.~~ure~~ 7 illustrates the peak power-to-average power ratio ~~obtained~~ based on the result of the actual simulation between the present invention and the ~~conventional~~ prior art. In order to provide ~~the~~ identical conditions, the power level of the control or signal channel ~~is has to be controlled at to be is set to~~ is set to the same the same ~~as the~~ power level of the communication channel (Fundamental channel, ~~s~~Supplemental ~~channel~~ channel; or ~~the~~ In-phase channel, ~~and~~ the Quadrature channel)~~,~~. ~~and~~ Additionally, the power level of the pilot channel ~~is has to be controlled so that it is to be~~ is set lower than the power level of the communication channel by 4dB. In the above-described ~~state~~ condition, the statistical distributions of the peak power-to-average power are compared.

In ~~the~~ the case of OCQPSK, ~~according to~~ in accordance with the present invention, the comparison is implemented by using the first complex multiplier 100 and the n-th complex multiplier 100n shown in Figure 4. The first block 100 is implemented based on $W_{M,11}=W_0$, $W_{M,12}=W_4$, $W_{M,13}=W_0$, and $W_{M,14}=W_1$, and the n-th block 100n is implemented based on $W_{M,n1}=W_0$,

$W_{M,n2}=W_4$, $W_{M,n3}=W_2$, and $W_{M,n4}=W_3$. In addition, the SCI is used as ~~the SCI for the~~

spreading code~~. In this case,~~ and the SC2 is not used.

In the case of OCQPSK, the probability that the instantaneous power exceeds the average power value (0 dB) by 4 dB is 0.03%, and in the case of CDMA ONE, ~~the same~~ it is 0.9%~~, and it is 4% in the case of the ETRI version 1.0, the same is 4%~~. Therefore, ~~in~~ the present invention~~, the system using the CDMA technique~~ has a very excellent characteristic ~~in the peak-to-average power ratio sense~~ with respect to the power efficiency~~,~~ and ~~the method, according to the present invention,~~ as ~~is~~ a new modulation method, it ~~which~~ ~~eliminates~~ reduces the ~~cross-talk~~ crosstalk interference problem.

Fig.~~ure~~ 9 illustrates a ~~permutated orthogonal complex spreading modulation (POCQPSK),~~ ~~according to~~ in accordance with the present invention. As shown therein, one or a plurality of channels are combined and complex-multiplied by the permuted ~~permutated~~ orthogonal Hadamard code and then are spread by the spreading code.

~~As shown therein, there~~ In Fig.~~ure~~ 9, the following items are provided: first and second Hadamard sequence multipliers 600 and 700 for ~~allocating the multichannel to~~ respectively having a predetermined number of channels allocated~~, splitting the same into two groups~~ and outputting $\alpha_{n1}W_{M,n1}X_{n1}$, which is obtained by multiplying the data X_{n1} of each channel by the gain α_{n1} and the orthogonal Hadamard sequence $W_{M,n1}$~~,~~; ~~and~~ $\alpha_{n2}W_{M,n2}X_{n2}$, which is obtained by multiplying the data X_{n2} of the gain α_{n2} and the orthogonal Hadamard sequence $W_{M,n2}$; a first adder 810 for outputting $\sum_{n=1}^{K}(\alpha_{n1}W_{M,n1}X_{n1})$, which is obtained by summing the output signals from the first Hadamard sequence multiplier 600; a second adder 820 for outputting $\sum_{n=1}^{K}(\alpha_{n2}W_{M,n2}X_{n2})$, which is obtained by summing the output signals from the second Hadamard

sequence multiplier 700~~,~~; a complex multiplier 900 for receiving the output signal from the first adder 810 and the output signal from the second adder 820 in the complex form of

$$\sum_{n=1}^{K}(\alpha_{n1}W_{M,n1}X_{n1}+j\alpha_{n2}W_{M,n2}X_{n2})$$ and complex-multiplying the received signal by

$W_{M,I}+jPW_{M,Q}$, which consist ~~n=1~~

of the orthogonal Hadamard code $W_{M,I}$, and the ~~permutated~~ permuted orthogonal Hadamard code $PW_{M,Q}$~~—,that~~ wherein $W_{M,Q}$ and a predetermined sequence P are ~~complex-multiplied~~ multiplied~~,~~; a spreading unit 300 for multiplying the output signal from the complex multiplier 900 by ~~the~~ a spreading code~~,~~; a filter 400 for filtering the output signal from the spreading unit 300~~,~~; and a modulator 500 for ~~multiplying and~~ modulating the output signal from the filter 400 by multiplying the modulation carrier wave, summing the in-phase signal and the quadrature phase signal and outputting a ~~modulation signal of the real number~~ real part of the modulated signal.

Additionally, in Fig.~~ure~~ 9 ~~Here,~~ the construction of the spreading unit 300, the filter 400 and the modulator 500 is the same as the embodiment of Fig~~ure~~ 4 ~~except for the following construction. Namely, comparing to the embodiment of Figure 4, in the construction of Figure 9,~~ However, in Fig. 9, the multiplication of the complex ~~type~~ orthogonal Hadamard sequence ~~performed by the complex multipliers 100 through 100n are~~ separated from the complex multiplier 100 through 100n and ~~connected~~ implemented in the rear portion of the summing unit,. ~~and the~~ The ~~channel-wise~~ multiplication of each channel by the complex ~~type~~ orthogonal [Harmard] Hadamard sequence is not implemented~~.~~ ~~Namely Thus,~~ and the ~~two-group~~ summed signals of two groups are ~~is~~ multiplied by the complex type orthogonal Hadamard sequence.

In ~~The~~ the first orthogonal Hadamard sequence multiplier 600 ~~outputs~~

~~$\sum_{n=1}^{K}(\alpha_{n1}W_{M,n1}X_{n1})$, which is summed by the first adder 810, by summing~~ $\alpha_{11}W_{M,11}X_{11}$,

through multiplier 610, 611, 620, 621, 630, 631, 640 and 641

~~which~~ is obtained ~~by the first adder 810~~ by multiplying ~~the~~ ~~orthogonal Hadamard sequence~~ ~~$W_{M,11}$~~ first data X_{11} of the first group by the ~~first data X_{11} of the first block~~ orthogonal Hadamard sequence $W_{M,11}$ and the gain α_{11}. ~~r~~Respectively, $\alpha_{21}W_{M,21}X_{21}$ ~~which~~ is obtained by multiplying ~~the orthogonal Hadamard sequence $W_{M,21}$ by~~ ~~the~~ the second data X_{21} of the first group ~~block~~ by ~~orthgomal~~ orthogonal Hadamard sequence $W_{M,21}$ and the gain α_{21}. Additionally~~,~~ ~~respectively,~~ ~~and~~ $\alpha_{n1}W_{M,n1}X_{n1}$ ~~which~~ is obtained by multiplying ~~the orthogonal Hadamard sequence $W_{M,n1}$ by~~ ~~the~~ n-th data X_{n1} of the first group ~~block~~ by orthogonal Hadamard sequence $W_{M,n1}$ and the gain α_{n1}.

The first adder 810 sums $\alpha_{n1}W_{M,n1}X_{n1}$ of each channel to output

$$\sum_{n=1}^{K}(\alpha_{11}W_{M,11}X_{11}).$$

~~The~~ In the second orthogonal Hadamard sequence multiplier 700, ~~outputs~~

~~$\sum_{n=1}^{K}(\alpha_{n2}W_{M,n2}X_{n2})$, which is summed by the second adder 820, by summing~~ $\alpha_{12}W_{M,12}X_{12}$,

through multiplier 720, 721, 730, 731, 740 and 741

~~which~~ is obtained by multiplying ~~the orthogonal Hadamard sequence $W_{M,12}$ by~~ the first data X_{12} of the second group ~~block~~ by the orthogonal Hadamard sequence $W_{M,12}$ and the gain α_{12}. ~~r~~Respectively, $\alpha_{22}W_{M,22}X_{22}$ ~~which~~ is obtained by multiplying the ~~orthogonal Hadamard sequence $W_{M,22}$ by~~ the second data X_{22} of the second ~~block~~ group by the Hadamard sequence $W_{M,22}$ and the gain α_{22}. ~~respectively~~Additionally, ~~and~~ $\alpha_{n2}W_{M,n2}X_{n2}$ ~~which~~ is obtained by multiplying ~~the orthogonal Hadamard sequence $W_{M,n2}$ by~~ the n-th data X_{n2} of the second group ~~block~~ by the orthogonal sequence $W_{M,n2}$ and the gain α_{n2}. ~~Here~~ ~~Thus, the~~

~~block represents one group split into 1 group.~~

The second adder 820 sums $\alpha_{n2}W_{M,n2}X_{n2}$ of each channel to output $\sum_{n=1}^{K}(\alpha_{n2}W_{M,n2}X_{n2})$.

The signal outputted from the first adder 810 forms an in-phase data~~,~~ and the signal outputted from the second adder 820 forms ~~an~~ quadrature phase data ~~and outputs~~ $\cancel{\sum_{n=1}^{K}(\alpha_{n1}W_{M,n1}X_{n1}+j\alpha_{n2}W_{M,n2}X_{n2})}$. In addition, the complex multiplier 900 ~~multiplies the~~ receives the output signals in the complex form from the first and second adder 810 and 820 and multiplies the complex output signals

$$\sum_{n=1}^{K}(\alpha_{n1}W_{M,n1}X_{n1}+j\alpha_{n2}W_{M,n2}X_{n2})$$

from the first and second adders 810 and 820 by a complex ~~type~~ signal of $W_{M,I}+jPW_{M,Q}$ that is comprised of an orthogonal ~~[Harmard]~~ Hadamard code $W_{M,I}$ and $PW_{M,Q}$, which results from the multiplication of the orthogonal ~~[Hardmard]~~ Hadamard code $W_{M,Q}$ by the sequence P. ~~and outputs an in-phase signal and a quadrature phase signal~~. ~~Namely, t~~The P is a predetermined sequence, spreading code or integer configured so that two consecutive sequences ~~sequence~~ have identical values. Accordingly, the complex output signals from the first and second adders 810 and 820 are complex-multiplied by the complex ~~type~~ signals of $W_{M,I}+jPW_{M,Q}$ by the complex multiplier 900.

The spreading unit 300 multiplies the output signal from the complex multiplier 900 by the spreading code SCI and spreads the same. Thus, ~~T~~the ~~thusly~~ spread signals are then filtered by the pulse shaping filters 410 and 420. The modulation carrier waves of $\cos(2\pi f_c t)$ and $\sin(2\pi f_c t)$ are ~~summed~~ multiplied by the modulation multipliers 510 and 520 ~~and then~~

~~modulated for thereby~~ thereby outputting s(t). ~~Namely,~~ In the following equation is obtained.

$$\left(\sum_{n=1}^{K}(\alpha_{n1}W_{M,n1}X_{n1}+j\alpha_{n2}W_{M,n2}X_{n2})\right)\otimes(W_{M,I}+jPW_{M,Q})\otimes SCI$$ where K represents an integer greater than or equal to 1.

Fig.~~ure~~ 10 illustrates an embodiment ~~that~~ where two channel data are complex-multiplied. ~~A c~~Channel data X_{11} is allocated to the first orthogonal Hadamard sequence multiplier 600 and another channel data X_{12} is allocated to the second orthogonal Hadamard sequence multiplier 700.

~~In Figure 10,~~ As shown, ~~Here,~~ the orthogonal Hadamard sequence multiplier includes the following: a first multiplier 610 ~~for multiplying the first data X_{11} by the gain α_{11},~~; a second multiplier 611 ~~for multiplying the output signal from the first multiplier 610 by the orthogonal Hadamard sequence $W_{M,11}$,~~; a third multiplier 710 ~~for multiplying the second data X_{12} by the gain α_{12},~~; and a fourth multiplier 711 ~~for multiplying the output signal from the third multiplier 710 by the orthogonal Hadamard sequence $W_{M,12}$. At this time Therefore, since one channel is allocated to only one group, the summing unit is not used.~~

The complex multiplier 900 includes the following: fifth and sixth multipliers 901 and 902 ~~for multiplying the output signal $\alpha_{11}W_{M,11}X_{11}$ from the second multiplier 611 and the output signal $\alpha_{12}W_{M,12}X_{12}$ from the fourth multiplier 711 by the orthogonal Hadamard sequence $W_{M,I}$,~~; seventh and eighth multipliers 903 and 904 ~~for multiplying the output signal $\alpha_{11}W_{M,11}X_{11}$ from the second multiplier 611 and the output signal $\alpha_{12}W_{M,12}X_{12}$ from the fourth multiplier 711 by the permutated orthogonal Hadamard sequence $PW_{M,Q}$,~~; a first adder 905 ~~for summing the output signal (+ac) from the fifth multiplier 901 and the output signal (-bd) from the seventh multiplier 903 and outputting an in-phase information (ac-bd),~~; and a second adder 906 ~~for summing the output signal (bc) from the sixth multiplier~~

~~902 and the output~~

~~signal (ad) from the eighth multiplier 904 and outputting an quadrature phase information (bc+ad)~~.

Therefore, the first and second multipliers 610 and 611 multiply the data X_{11} by the orthogonal Hadamard sequence $W_{M,11}$ and the gain α_{11} ~~for~~ thereby ~~obtaining~~ outputting $\alpha_{11}W_{M,11}X_{11}$(=a). In addition, the third and fourth multipliers 710 and 711 multiply the data X_{12} by the orthogonal Hadamard sequence $W_{M,12}$ and the gain α_{12} ~~for~~ thereby ~~obtaining~~ outputting $\alpha_{12}W_{M,12}X_{12}$(=b). The fifth and sixth multipliers 901 and 902 multiply $\alpha_{11}W_{M,11}X_{11}$(=a) and $\alpha_{12}W_{M,12}X_{12}$(=b) by the orthogonal Hadamard sequence $W_{M,I}$(=c) ~~for~~ thereby ~~obtaining~~ generating $\alpha_{11}W_{M,11}X_{11}W_{M,I}$(=ac) and $\alpha_{12}W_{M,12}X_{12}W_{M,I}$(=bc). The seventh and eighth multipliers 903 and 904 multiply $\alpha_{11}W_{M,11}X_{11}$(=a) and $\alpha_{12}W_{M,12}X_{12}$(=b) by the permuted ~~permutated~~ orthogonal Hadamard sequence $PW_{M,Q}$ ~~for~~ thereby generating ~~obtaining~~ $\alpha_{11}W_{M,11}X_{11}PW_{M,Q}$(=ad) and $\alpha_{12}W_{M,12}X_{12}PW_{M,Q}$(=bd).

~~In addition, t~~The first adder 905 outputs ~~obtains~~ $(\alpha_{11}W_{M,11}X_{11}W_{M,I})-(\alpha_{12}W_{M,12}X_{12}PW_{M,Q})$ (=ac-bd). ~~namely~~ ~~Specifically~~ That is, $\alpha_{12}W_{M,12}X_{12}PW_{M,Q}$(bd) is subtracted from $\alpha_{11}W_{M,11}X_{11}W_{M,I}$(=ac). ~~and t~~The second adder 906 generates ~~obtains~~ $(\alpha_{11}W_{M,11}X_{11}PW_{M,Q})+(\alpha_{12}W_{M,12}X_{12}W_{M,I})$(=ad+bc). ~~namely,~~ ~~Then~~ That is, $(\alpha_{11}W_{M,11}X_{11}PW_{M,Q})$(=ad) is summed by $(\alpha_{12}W_{M,12}X_{12}W_{M,I})$ (bc).

Fig.~~ure~~ 10 illustrates the complex multiplier 900 shown in Fig.~~ure~~ 9. For example, ~~Assuming that~~ $\alpha_{11}W_{M,11}X_{11}$ is "a", $\alpha_{12}W_{M,12}X_{12}$ is "b", the orthogonal Hadamard sequence $W_{M,I}$ is "c", and the permuted ~~permutated~~ orthogonal Hadamard sequence $PW_{M,Q}$ is "d". ~~s~~Since (a+jb)(c+jd)=ac-bd+j(bc+ad), the signal from the complex multiplier 900 ~~becomes~~ consists of the in-phase information ac-bd and the quadrature phase information bc+ad.

The in-phase ~~data~~ and ~~the~~ quadrature phase ~~data~~ information is ~~are~~ spread by the

spreading unit 300 based on the spreading code (for example, PN code). In addition, the I channel signal, which is the in-phase information, and the Q channel signal, which is the quadrature phase information signal, are filtered by the first and second pulse shaping filters 410 and 420. The first and second multipliers 510 and 520 multiply the output signals from the first and second pulse shaping filters 410 and 420 by $\cos(2\pi f_c t)$ and $\sin(2\pi f_c t)$. The output signals from the multipliers 510 and 520 are summed ~~and modulated~~ by the adder 530 which outputs S(t).

~~In t~~The embodiment as shown in Fig.~~ure~~ 9~~, identically to the embodiment as shown in~~ is identical to Fig.~~ure~~ 4~~, for the~~ ~~because~~ instead of orthogonal Hadamard sequence, ~~the~~ Walsh code or other orthogonal code may be used. In addition, in the orthogonal Hadamard sequence of each channel, the sequence vector of the k-th column or row is set to W_{k-1} in the MxM Hadamard matrix. ~~Therefore,~~ Preferably, $\alpha_{n1}W_0X_{n1}+j\alpha_{n2}W_{2p}X_{n2}$ and W_0+jPW_1 are complex-multiplied

based on $W_{M,n1}=W_0$, $W_{M,n2}=W_{2p}$ (where p represents a predetermined number in a range from 0 to (M/2)-1~~.~~, and $W_{M,I}=W_0$, $W_{M,Q}=W_1$.

The orthogonal Hadamard sequence is allocated to each channel based on the above-described operation, and if ~~there remain~~ other channels remain which are not allocated the orthogonal Hadamard sequence by the above-described operation~~, and if there remain other channel which are not allocated the orthogonal Hadamard sequence by the above-described operation,~~ then any row or column vector from the Hamard matrix can be selected.

Fig.~~ure~~ 11 illustrates an embodiment of ~~the POCQPSK for the voice service~~ a permuted orthogonal complex spreading apparatus with two input channels. In this case, the data of two channels, namely, the pilot channel and the data of traffic channels are

multiplied by the gain and orthogonal Hadamard sequence~~,~~. ~~and~~ The two channel signals are then inputted into the complex multiplier 900 in the complex ~~type~~ form ~~,~~ and the orthogonal Hadamard sequence of the complex ~~type~~ form is multiplied by the complex multiplier 900.

Fig.~~ure~~ 12 illustrates ~~the construction of a data service having a good quality voice service and low transmission rate~~ an embodiment of a permuted orthogonal complex spreading apparatus with three input channels. ~~In this case, t~~The pilot channel and signaling channel are allocated to the first orthogonal Hadamard sequence multiplier 700~~,~~ and the traffic channel is allocated to the second orthogonal Hadamard sequence multiplier 700.

Fig.~~ure~~ 13A illustrates ~~the construction for a high transmission rate data service of a high transmission rate.~~ an embodiment of a permuted orthogonal complex spreading apparatus with four input channels. ~~As shown therein, the d~~Data ~~transmitted at a rate of R bps has the QPSK data type and are~~ is ~~transmitted at R/2 bps through the serial to parallel converter.~~ ~~As shown i~~In Fig.~~ure~~ 13B, the system may be ~~constituted~~ constructed so that the input data (traffic 1 and traffic 2) have ~~the~~ identical gains ($\alpha_{31}=\alpha_{12}$). ~~Here~~Therefore~~, when the data having high transmission rates are separated into two channels, the gain allocated to each channel should be determined to the identical gain for thereby eliminating the phase dependency~~.

Fig.~~ures~~ 14A and 14B illustrate an embodiment of a permuted orthogonal complex spreading apparatus with five input channels. ~~the construction of the multichannel service. In this case, the d~~Data ~~(traffic) having a high transmission rate is converted into the QPSK data for R/2 bps through the serial to parallel converter and then is distributed to the first orthogonal Hadamard sequence multiplier 600 and the second Hadamard sequence multiplier 700.,~~ ~~and~~ ~~Then three channels are allocated to the first orthogonal Hadamard sequence multiplier 600 and two channels are allocated to the second orthogonal Hadamard~~

~~sequence multiplier 700.~~

~~As shown i~~In Fig.~~ure~~ 14B, ~~the serial to parallel converter is not used, and~~ when the data (~~t~~Traffic) is separated into two channel data (Traffic 1) and (~~t~~Traffic 2) and then is inputted, the gains adapted to each channel ~~adapts~~ are identical ~~the identical gains~~ ($\alpha31=\alpha12$).

Fig.~~ure~~ 15A is a phase trajectory view of an OCQPSK, according to the present invention~~;~~. Fig.~~ure~~ 15B is a phase trajectory view of a POCQPSK, according to the present invention.~~;~~ ~~and~~ Fig.~~ure~~ 15C is a phase trajectory view of a complex spreading method, according to PN complex spreading method of the ~~present invention~~ prior art.

~~t~~The shapes of the trajectories ~~and~~ around the zero points are different ~~As shown therein,~~ when comparing ~~the embodiments of~~ Figs.~~ure~~ 15A, 15B and 15C~~;~~. ~~the shapes of the trajectories and the zero points are different. In a view of the power efficiency, tThere is also a difference with the power efficiency~~. This difference indicates the difference between the three methods. ~~Therefore, the statistical distribution of the peak power-to-average power ratio is different.~~

Fig.~~ure~~ 7 illustrates ~~a characteristic illustrating~~ a statistical distribution of a peak power-to-average power ratio of the CDMA ONE method compared to the OCQPSK ~~method~~ and ~~the~~ POSQPSK methods.

In order to provide the identical condition the following has to occur: ~~the~~ power level of the signal channel is controlled to be the same as the power level of the communication channel; ~~and the~~ power level of the pilot channel is controlled to be lower than the power

level of the communication channel by 4dB. ~~and then the statistical distribution of the peak power-to-average power ratio is compared~~.

In the case of the POCQPSK, ~~according to the present invention~~, in the first block 600 of Fig.~~ure~~ 9, $W_{M,11}=W_0$, and $W_{M,21}=W_2$ are implemented~~,~~ and in the second block 700~~,~~ $W_{M,12}=W_4$, and $W_{M,I}=W_0$ and $W_{M,Q}=W_1$ are implemented. For the value of P, the spreading code is used so that two consecutive ~~two~~ sequences have ~~the~~ an identical value.

For example, the probability that the instantaneous power exceeds the average power value (0dB) by 4dB is 0.1% based on POCQPSK, and the complex spreading method is 2%. Therefore, in view of the power efficiency, the method ~~adapting the CDMA technique,~~ ~~according to~~ in accordance with the present invention, is a new modulation method having excellent characteristics.

As described above, in the OCQPSK ~~according to~~ in accordance with the present invention, the first data and the second data are multiplied by the gain and orthogonal code, and the resultant values are complex-summed, and the complex summed value is complex-multiplied by ~~the~~ a complex type orthogonal code. ~~The~~ A method is utilized where ~~that~~ the information of the multichannel of the identical structure is summed and then spread ~~is used~~. Therefore, this method statistically reduces the peak power-to-average power ratio to the desired range.

~~In addition~~Additionally, in the POCQPSK ~~according to the present invention,~~ the data of the first block and the data of the second block are multiplied by the gain and the orthogonal code, respectively, and the permuted ~~permutated~~ orthogonal spreading code of the complex type is complex-multiplied and then spread. Therefore, this method statistically reduces the peak power-to-average power ratio to the desired range~~,~~. Utilizing the combined orthogonal Hadamard sequence, ~~and~~ it is possible to decrease the phase dependency based in ~~the~~ multichannel ~~interference~~ and ~~the~~ multiuser interference ~~using the combined orthogonal Hadamard sequence~~.

Although, the preferred embodiments of the present invention have been disclosed for illustrative purposes~~,~~ ~~T~~those skilled in the art will appreciate that various modifications, additions and substitutions are possible, without departing from the scope and spirit of the invention as recited in the accompanying claims.

WHAT IS CLAIMED IS:

~~1. An orthogonal complex spreading method for a multichannel, comprising the steps of:~~

~~complex-summing $\alpha_{n1}W_{M,n1}X_{n1}$, which is obtained by multiplying an orthogonal Hadamard sequence $W_{M,n1}$ by a first data X_{n1} and gain α_{n1} of a n-th block, and $\alpha_{n2}W_{M,n2}X_{n2}$, which is obtained by multiplying an orthogonal Hadamard sequence $W_{M,n2}$ by a second data X_{n2} and gain α_{n2} of a n-th block;~~

~~complex-multiplying $\alpha_{n1}W_{M,n1}X_{n1}+j\alpha_{n2}W_{M,n2}X_{n2}$, which is summed in the complex type, and $W_{M,n3}+jW_{M,n4}$ of the complex type using a complex multiplier and outputting as an in-phase information and quadrature phase information; and~~

~~summing only said in-phase information outputted from a plurality of blocks and said only quadrature phase information outputted therefrom from a plurality of blocks and spreading the same using a spreading code.~~

~~2. The method of claim 1, wherein said spreading code spreads to an I channel and Q channel using the in-phase information and the quadrature phase information as one spreading code.~~

~~3. The method of claim 1, wherein said spreading code is spread to an said I channel signal by multiplying an said in-phase information and an said quadrature phase information by a first spreading code, multiplying the in-phase information and the~~

~~quadrature phase information by a second spreading code and forming~~ said ~~I channel signal by subtracting the quadrature phase information to which the second spreading code is multiplied from the in-phase information to which the first spreading code is multiplied and forming~~ said ~~Q channel signal by summing the quadrature phase information to which the first spreading code is multiplied and the in-phase information to which the second spreading code is multiplied.~~

~~4. The method of claim 1, wherein said orthogonal Hadamard sequence uses a Walsh code.~~

~~5. The method of claim 1, wherein in said step for multiplying the orthogonal Hadamard sequence, a sequence vector of a k-th column or row is set to W_{k-1} in a MxM (M=4) Hadamard matrix, and in the case of one block, $\alpha_{11}W_0X_{11}+j\alpha_{12}W_2X_{12}$ and $W_{0O}+jW_1$ is complex-multiplied based on $W_{M,11}=W_0$, $W_{M,12}=W_2$, and $W_{M,13}=W_0$, $W_{M,14}=W_1$.~~

~~6. The method of claim 5, wherein $\alpha_{11}W_0X_{11}+j\alpha_{12}W_4X_{12}$ and W_0+jW_1 are complex-multiplied based on M=8 and $W_{M,12}=W_4$.~~

~~7. The method of claim 1, wherein in said step for multiplying the orthogonal Hadamard sequence, a sequence vector of a~~ said ~~k-th column or row is set to a W_{k-1} in a~~

~~MxM (M is a natural number) Hadamard matrix, and $\alpha_{n1}W_0X_{n1}+j\alpha_{n2}W_{2P}X_{n2}$ and $W_{2n-2}+jW_{2n-1}$ are complex-multiplied based on $W_{M,n1}=W_0$, $W_{M,n2}=W_{2p}$ (where p represents a predetermined number in a range from 0 to (M/2)-1) and $W_{M,n3}=W_{2n-2}$, $W_{M,n4}=W_{2n-1}$ (where n represents a~~

~~n-th block number).~~

~~8. The method of claim 1, wherein in the case of two blocks, a resultant value which is obtaining by setting a sequence vector of a~~ said ~~k-th column or row to a W_{k-1} in a MxM (M=8) Hadamard matrix and complex-multiplying $\alpha_{11}W_0X_{11}+j\alpha_{12}W_4X_{12}$ and W_0+jW_1 based on $W_{M,11}=W_0$, $W_{M,12}=W_4$, $W_{M,13}=W_0$, $W_{M,14}=W_1$, and a resultant value which is obtained by complex-multiplying $\alpha_{21}W_0X_{21}+j\alpha_{22}W_4X_{22}$ and W_2+jW_3 based on $W_{M,21}=W_0$, $W_{M,22}=W_4$, $W_{M,23}=W_2$, $W_{M,24}=W_3$ are summed.~~

~~9. The method of claim 8, wherein a~~ said ~~resultant value which is obtained by complex-multiplying $\alpha_{11}W_0X_{11}+j\alpha_{12}W_6X_{12}$ and W_0+jW_1 based on $W_{M,12}=W_6$, and $W_{M,22}=W_6$, and $\alpha_{21}W_0X_{21}+j\alpha_{22}W_6X_{22}$ and W_2+jW_3 are summed.~~

~~10. An orthogonal complex spreading apparatus, comprising:~~

~~a plurality of complex multiplication blocks for distributing the data of the multichannel and complex signal~~ $\cancel{\alpha_{n1}W_{M,n1}X_{n1}+j\alpha_{n2}W_{M,n2}X_{n2}}$~~, of which~~ $\cancel{\alpha_{n1}W_{M,n1}X_{n1}}$ ~~which is obtained by multiplying the orthogonal Hadamard sequence~~ $\cancel{W_{M,n1}}$ ~~with the first data~~ $\cancel{X_{n1}}$ ~~of the n-th block and the gain~~ $\cancel{\alpha_{n1}}$ ~~and~~ $\cancel{\alpha_{n2}W_{M,n2}X_{n2}}$ ~~which is obtained by multiplying the orthogonal Hadamard sequence~~ $\cancel{W_{M,n2}}$ ~~with the second data~~ $\cancel{X_{n2}}$ ~~of the n-th block and the gain~~ $\cancel{\alpha_{n2}}$ ~~are constituents, are complex-multiplied by~~ $\cancel{W_{M,n3}+jW_{M,n4}}$ ~~using the~~ a ~~complex multiplier;~~

~~a summing unit for summing only the in-phase information outputted from each block of the plurality of the complex multiplication blocks and summing only the quadrature phase information outputted from each block of the plurality of the complex multiplicator blocks; and~~

~~a spreading unit for multiplying the in-phase information and the quadrature phase information which are summed by the summing unit by the spreading code and outputting an I channel and a Q channel.~~

~~11. The apparatus of claim 10, wherein in said spreading unit, the in-phase information and the quadrature phase information summed by the summing unit are multiplied by the first and~~ the ~~second spreading codes, the quadrature phase information to which the second spreading code is multiplied is subtracted from the in-phase information to which the first spreading code is multiplied for thereby outputting an~~ said ~~I channel, and the in-phase information to which the second spreading code is summed by the quadrature phase information to which the first spreading code is multiplied for thereby outputting a~~ said ~~Q channel.~~

~~12. The apparatus of claim 10, wherein said complex multiplication block includes:~~

~~a first multiplier for multiplying the first data~~ ~~X_{n1}~~ ~~of a corresponding block by the orthogonal Hadamard sequence~~ ~~$W_{M,n1}$;~~

~~a second multiplier for multiplying the~~ an ~~output signal from the first multiplier by the gain~~ ~~α_{n1};~~

~~a third multiplier for multiplying the second data~~ ~~X_{n2}~~ ~~by the orthogonal Hadamard sequence~~ ~~$W_{M,n2}$;~~

~~a fourth multiplier for multiplying the output signal from the third multiplier by the gain~~ ~~α_{n2};~~

~~fifth and sixth multipliers for multiplying the output signal~~ ~~$\alpha_{n1}W_{M,n1}X_{n1}$~~ ~~from the second multiplier and the output signal~~ ~~$\alpha_{n2}W_{M,n2}X_{n2}$~~ ~~from the fourth multiplier by the orthogonal Hadamard sequence~~ ~~$W_{M,n3}$;~~

~~seventh and eighth multipliers for multiplying the output signal~~ ~~$\alpha_{n1}W_{M,n1}X_{n1}$~~ ~~from the second multiplier and the output signal~~ ~~$\alpha_{n2}W_{M,n2}X_{n2}$~~ ~~from the fourth multiplier by the orthogonal Hadamard sequence~~ ~~$W_{M,n4}$;~~

~~a first adder for summing the output signal (ac) from the fifth multiplier and the~~ a ~~minus output signal (-bd) from the eighth multiplier and outputting an in-phase information (ac-bd); and~~

~~a second adder for summing the output signal (bc) from the sixth multiplier and the output signal (ad) from the seventh multiplier and outputting a quadrature phase information (bc+ad).~~

~~13. The apparatus of claim 10, wherein said orthogonal Hadamard sequence uses a predetermined type of the orthogonal code.~~

~~14. A permutated orthogonal complex spreading method for a multichannel, comprising the steps of:~~

~~complex-summing $\alpha_{n1}W_{M,n1}X_{n1}$ which is obtained by multiplying a predetermined orthogonal Hadamard sequence $W_{M,n1}$ by a data X_{n1} and a gain α_{n1} and $\alpha_{n2}W_{M,n2}X_{n2}$ which is obtained by multiplying the orthogonal Hadamard sequence $W_{M,n2}$ of the a second block by a predetermined data X_{n2} and a gain α_{n2} in the a first block during a multichannel data distribution;~~

~~summing only the in-phase information based on the output signals from a plurality of other channels from two blocks and summing only the quadrature phase information; and complex-multiplying~~

~~$\sum_{n=1}^{K}(\alpha_{n1}W_{M,n1}X_{n1}+j\alpha_{n2}W_{M,n2}X_{n2})$ which are summed in the complex type and~~

~~$W_{M,I}+jPW_{M,Q}$ which are formed of P representing a said predetermined sequence or a spreading code or a predetermined integer using a complex multiplier and $W_{M,I}$ and $W_{M,Q}$ which are the orthogonal Hadamard sequences, and outputs the a signal as an said in-phase information and a said quadrature phase information.~~

~~15. The method of claim 14, wherein said spreading code spreads the in-phase information and the quadrature phase information to an I channel and Q channel using one spreading code.~~

~~16. The method of claim 14, wherein P represents a said predetermined sequence or a said predetermined spreading code or a said predetermined integer.~~

~~17. The method of claim 14, wherein a sequence vector of the k-th column or row is set to W_{k-1} based on the MxM Hadamard matrix, the conditions $W_{M,I}=W_0$, $W_{M,Q}=W_{2q+1}$ (where q represents a predetermined number in a range from 0 to (M/2)-1) are obtained, and a said predetermined spreading code for P is configured so that two consecutive two sequences have the identical values.~~

~~18. The method of claim 14, wherein P is varied in accordance with a communication environment and service type.~~

~~19. The method of claim 14, wherein said orthogonal Hadamard sequence uses a Walsh code.~~

~~20. The method of claim 14, wherein in said step for multiplying the orthogonal Hadamard sequences, the sequence vector of the k-th column or row is set to W_{k-1} based on the MxM (M=4) Hadamard matrix, and in the case that two data are transmitted, the conditions $W_{M,11}=W_0$, $W_{M,12}=W_2$, and $W_{M,I}=W_0$, $W_{M,Q}=W_1$ are determined for thereby complex-multiplying $\alpha_{11}W_0X_{11}+j\alpha_{12}W_2X_{12}$ and W_0+jPW_1.~~

~~21. The method of claim 20, wherein said $\alpha_{11}W_0X_{11}+j\alpha_{12}W_4X_{12}$ and said W_0+jPW_1 are complex-multiplied based on M=8 and $W_{M,12}=W_4$.~~

~~22. The method of claim 14, wherein in said step for multiplying the orthogonal Hadamard sequence, a~~ said ~~sequence vector of the k-th column or row is set to W_{k-1} based on the MxM Hadamard matrix, the conditions $W_{M,n1}=W_0$, $W_{M,n2}=W_{2q+1}$ (where q represents a predetermined number in a range from 0 to (M/2)-1) are obtained and the conditions $W_{M,I}=W_0$, $W_{M,Q}=W_1$ (where n represent a n-th block number)~~ are utilized ~~for thereby complex-multiplying $\alpha_{n1}W_0X_{n1}+j\alpha_{n2}W_{2q}X_{n2}$ and W_0+jPW_1.~~

~~23. The method of claim 14, wherein in said~~ a ~~spreading unit, the in-phase information and the quadrature phase information summed by the summing unit are multiplied by the first and second spreading codes, the quadrature phase information to which the second spreading code is multiplied is subtracted from the in-phase information to which the first spreading code is multiplied for thereby forming an~~ said ~~I channel, and the in-phase information to which the second spreading code is multiplied is summed by the quadrature phase information to which the first spreading code is multiplied for thereby outputting a~~ said ~~Q channel.~~

~~24. The method of claim 14, wherein said complex multiplication block includes:~~

~~a first multiplier for multiplying the first data X_{n1} of a corresponding block by the gain α_{n1};~~

~~a second multiplier for multiplying the output signal from the first multiplier by the orthogonal Hadamard sequence $W_{M,n1}$;~~

~~a third multiplier for multiplying the second data X_{n2} by the gain α_{n2};~~

~~a fourth multiplier for multiplying the output signal from the third multiplier by the~~

~~orthogonal Hadamard sequence~~ ~~$W_{M,n2}$;~~

~~fifth and sixth multipliers for multiplying the output signal~~ ~~$\alpha_{n1}W_{M,n1}X_{n1}$~~ ~~from the second multiplier and the output signal~~ ~~$\alpha_{n2}W_{M,n2}X_{n2}$~~ ~~from the fourth multiplier by the orthogonal Hadamard sequence~~ ~~$W_{M,I}$;~~

~~seventh and eighth multipliers for multiplying the output signal~~ ~~$\alpha_{n1}W_{M,n1}X_{n1}$~~ ~~from the second multiplier and the output signal~~ ~~$\alpha_{n2}W_{M,n2}X_{n2}$~~ ~~from the fourth multiplier by the orthogonal Hadamard sequence~~ ~~$W_{M,Q}$;~~

~~a first adder for summing the output signal (ac) from the fifth multiplier and the minus output signal (-bd) from the eighth multiplier and outputting an in-phase information (ac-bd); and~~

~~a second adder for summing the output signal (bc) from the sixth multiplier and the output signal (ad) from the seventh multiplier and outputting a quadrature phase information (bc+ad).~~

~~25. The apparatus of claim 14, wherein a combined orthogonal Hadamard sequence is used instead of the orthogonal Hadamard sequence in order to eliminate the phase dependency due to an interference occurring with a multipath type of a self signal and an interference occurring by other users.~~

~~26. A permutated orthogonal complex spreading apparatus for a multichannel, comprising:~~

~~first and second Hadamard sequence multipliers for allocating the multichannel to a predetermined number of channels, splitting the same into two groups and outputting~~ $\cancel{\alpha_{n1}W_{M,n1}X_{n1}}$ ~~which is obtained by multiplying the data~~ $\cancel{X_{n1}}$ ~~of each channel by the gain~~ $\cancel{\alpha_{n2}}$ ~~and the orthogonal Hadamard sequence~~ $\cancel{W_{M,n1}}$~~;~~

~~a first adder for outputting~~

$$\cancel{\sum_{n=1}^{K}(\alpha_{n1}W_{M,n1}X_{n1})}$$ ~~which is obtained by summing the output signals from the first Hadamard sequence multiplier;~~

~~a second adder for outputting~~

$$\cancel{\sum_{n=1}^{K}(\alpha_{n2}W_{M,n2}X_{n2})}$$ ~~which is obtained by summing the output signals from the second Hadamard sequence multiplier;~~

~~a complex multiplier for receiving the output signal from the first adder and the output signals from the second adder in the complex form of~~

$$\cancel{\sum_{n=1}^{K}(\alpha_{n1}W_{M,n1}X_{n1}+j\alpha_{n2}W_{M,n2}X_{n2})}$$ ~~and complex-multiplying~~ $\cancel{W_{M,I}+jPW_{M,Q}}$ ~~which consist of the orthogonal Hadamard code~~ $\cancel{W_{M,I}}$~~, and the permutated orthogonal Hadamard code~~ $\cancel{PW_{M,Q}}$ ~~that~~ $\cancel{W_{M,Q}}$ ~~and a predetermined sequence P are complex-multiplied;~~

~~a spreading unit for multiplying the output signal from the complex multiplier by the spreading code;~~

~~a filter for filtering the output signal from the spreading unit; and~~

~~a modulator for multiplying and modulating the modulation carrier wave, summing the in-phase signal and the quadrature phase signal and outputting a modulation signal of the a real number.~~

~~27. The method of claim 26, wherein in the case of three channels, a sequence vector of the a k-th column or row is set to W_{k-1} based on the a MxM (M=8) Hadamard matrix, and $W_{M,11}=W_0$, $W_{M,12}=W_4$, $W_{M,21}=W_2$, and $W_{M,I}=W_0$, $W_{M,Q}=W_1$ are determined, and the summed value which is obtained by summing $\alpha_{11}W_0X_{11}+j\alpha_{12}W_4X_{12}$, and $\alpha_{21}W_2X_{21}$ is complex-multiplied by W_0+jPW_1.~~

~~28. The method of claim 26, wherein in the case of the three channels, a the sequence vector of the k-th column or row is set to W_{k-1} based on the MxM Hadamard matrix, and $W_{M,11}=W_0$, $W_{M,12}=W_2$, and $W_{M,I}=W_0$, $W_{M,Q}=W_1$ are determined based on M=8, and the summed value which is obtained by summing $\alpha_{11}W_0X_{11}+j\alpha_{12}W_2X_{12}$ and $\alpha_{21}W_8X_{21}$ is complex-multiplied by W_0+jPW_1 based on M=16.~~

~~29. The method of claim 26, wherein in the case of four channels, a said sequence vector of the k-th column or row is set to W_{k-1} based on the MxM (M=8) Hadamard matrix, and $W_{M,11}=W_0$, $W_{M,12}=W_4$, $W_{M,21}=W_2$, $W_{M,31}=W_6$, and $W_{M,I}=W_0$, $W_{M,Q}=W_1$ are determined, and the summed value which is obtained by summing $\alpha_{11}W_0X_{11}+j\alpha_{12}W_4X_{12}$, $\alpha_{21}W_2X_{21}$ and $\alpha_{31}W_6X_{31}$ is complex-multiplied by W_0+jPW_1.~~

~~30. The method of claim 26, wherein said in the case of said four channels, a sequence vector of the k-th column or row is set to W_{k-1} based on the MxM Hadamard matrix, and $W_{M,11}=W_0$, $W_{M,12}=W_4$, $W_{M,31}=W_2$, $W_{M,I}=W_0$, $W_{M,Q}=W_1$ are determined based on M=8 and $W_{M,21}=W_8$ is determined based on M=16, and the summed value which is obtained by summing $\alpha_{11}W_0X_{11}+j\alpha_{12}W_4X_{12}$, $\alpha_{21}W_8X_{21}$ and $\alpha_{31}W_2X_{31}$ is complex-multiplied by W_0+jPW_1.~~

~~31. The method of claim 26, wherein in the case of five channels, a said sequence vector of the k-th column or row is set to W_{k-1} based on the MxM (M=8) Hadamard matrix, and $W_{M,11}=W_0$, $W_{M,12}=W_4$, $W_{M,21}=W_2$, $W_{M,31}=W_6$, $W_{M,22}=W_1$, and $W_{M,I}=W_0$, $W_{M,Q}=W_1$ are determined, and the summed value which is obtained by summing $\alpha_{11}W_0X_{11}+j\alpha_{12}W_4X_{12}$, $\alpha_{21}W_8X_{21}+j\alpha_{22}W_1X_{22}$ and $\alpha_{31}W_6X_{31}$ is complex-multiplied by W_0+jPW_1.~~

~~32. The method of claim 26, wherein in the case of said five channels, a said sequence vector of the k-th column or row is set to W_{k-1} based on the MxM (M=8) Hadamard matrix, and $W_{M,11}=W_0$, $W_{M,12}=W_4$, $W_{M,21}=W_2$, $W_{M,31}=W_6$, $W_{M,22}=W_3$, and $W_{M,I}=W_0$, $W_{M,Q}=W_1$ are determined, and the summed value which is obtained by summing $\alpha_{11}W_0X_{11}+j\alpha_{12}W_4X_{12}$, $\alpha_{21}W_8X_{21}+j\alpha_{22}W_3X_{22}$ and $\alpha_{31}W_6X_{31}$ is complex-multiplied by W_0+jPW_1.~~

~~33. The method of claim 26, wherein in the case of said five channels, a said sequence vector of the k-th column or row is set to W_{k-1} based on the MxM Hadamard matrix, and $W_{M,11}=W_0$, $W_{M,12}=W_4$, $W_{M,31}=W_2$, $W_{M,22}=W_6$, and $W_{M,I}=W_0$, $W_{M,Q}=W_1$ are determined based on M=8 and $W_{M,21}=W_8$ is determined based on M=16, and the summed value which is obtained by summing $\alpha_{11}W_0X_{11}+j\alpha_{12}W_4X_{12}$, $\alpha_{21}W_8X_{21}+j\alpha_{22}W_6X_{22}$ and $\alpha_{31}W_2X_{31}$ is complex-multiplied W_0+jPW_1.~~

~~34. The method of claim 29, wherein a gain α_{n1} and a gain α_{n2} are the identical gain in order to remove the phase dependency by an interference occurring in a multipath of a self signal and an interference occurring by other users.~~

~~35. The method of claim 29, wherein a gain α_{12} and a gain α_{31} are the identical gain in order to remove the phase dependency by an interference occurring in a multipath of a self signal and an interference occurring by other users.~~

~~36. The method of claim 26, wherein a combined orthogonal Hadamard sequence is used instead of the orthogonal Hadamard sequence in order to eliminate the phase dependency due to an interference occurring with a multipath type of a said self signal and said an interference occurring by other users.~~

~~37. The method of claim 36, wherein in the case of two channels, a said sequence vector of the k-th column or row of the MxM (M=8) Hadamard matrix is set to W_{k-1}, and a sequence vector of the m-th column or row is set to W_m, the first M/2 or the last M/2 is obtained from the vector W_{k-1}, and the last M/2 or the first M/2 is obtained from W_{m-1}, so that the combined orthogonal Hadamard vector is set to $W_{k-1//m-1}$, and the summed value of~~

~~$\alpha_{11}W_0X_{11}+j\alpha_{12}W_{4//1}X_{12}$ and $W_0+jPW_{1//4}$ are complex-multiplied based on $W_{M,11}=W_0$, $W_{M,12}=W_{4//1}$, and $W_{M,I}=W_0$, $W_{M,Q}=W_{1//4}$.~~

~~38. The method of claim 36, wherein in the case of~~ said ~~three channels, a~~ said ~~sequence vector of the k-th column or row of the MxM (M=8) Hadamard matrix is set to W_{k-1}, and a sequence vector of the m-th column or row is set to W_m, the first M/2 or the last M/2 is obtained from the vector W_{k-1}, and the last M/2 or the first M/2 is obtained from W_{m-1}, so that the combined orthogonal Hadamard vector is set to $W_{k-1//m-1}$, and the summed value of $\alpha_{11}W_0X_{11}+j\alpha_{12}W_{4//1}X_{12}$ and $\alpha_{21}W_2X_{21}$ and $W_0+jPW_{1//4}$ are complex-multiplied based on $W_{M,11}=W_0$, $W_{M,12}=W_{4//1}$, $W_{M,21}=W_2$, and $W_{M,I}=W_0$, $W_{M,Q}=W_{1//4}$.~~

~~39. The method of claim 36, wherein in the case of~~ said ~~two channels, a~~ said ~~sequence vector of the k-th column or row of the MxM (M=8) Hadamard vector matrix is set to W_{k-1}, and a~~ said ~~sequence vector of the m-th column or row is set to W_m, the first M/2 or the last M/2 is obtained from the vector W_{k-1}, and the last M/2 or the first M/2 is obtained from W_{m-1}, so that the combined orthogonal Hadamard vector is set to $W_{k-1//m-1}$, and the summed value of $\alpha_{11}W_0X_{11}+j\alpha_{12}W_{2//1}X_{12}$ and $W_0+jPW_{1//2}$ are complex-multiplied based on $W_{M,11}=W_0$, $W_{M,12}=W_{2//1}$, and $W_{M,I}=W_0$, $W_{M,Q}=W_{1//2}$.~~

~~40. The method of claim 36, wherein in the case of~~ said ~~three channels, a~~ said

~~sequence vector of the k-th column or row of the MxM (M=8) Hadamard vector matrix is set to~~ $\cancel{W_{k-1}}$~~, and a said sequence vector of the m-th column or row is set to~~ $\cancel{W_m}$~~, the first M/2 or the last M/2 is obtained from the vector~~ $\cancel{W_{k-1}}$~~, and the last M/2 or the first M/2 is obtained from~~ $\cancel{W_{m-1}}$~~, so that the combined orthogonal Hadamard vector is set to~~ $\cancel{W_{k-1//m-1}}$~~, and the summed value of~~ $\cancel{\alpha_{11}W_0X_{11}+j\alpha_{12}W_{2//1}X_{12}}$ ~~and~~ $\cancel{\alpha_{21}W_4X_{21}}$ ~~and~~ $\cancel{W_0+jPW_{1//2}}$ ~~are complex-multiplied based on~~ $\cancel{W_{M,11}=W_0}$~~,~~ $\cancel{W_{M,12}=W_{2//1}}$~~,~~ $\cancel{W_{M,21}=W_4}$~~, and~~ $\cancel{W_{M,I}=W_0}$~~,~~ $\cancel{W_{M,Q}=W_{1//2}}$~~.~~

~~ABSTRACT OF THE DISCLOSURE~~

~~An orthogonal complex spreading method and apparatus for a multichannel and an apparatus thereof are disclosed. The method includes includes the following steps: of complex-summing~~ $\cancel{\alpha_{n1}W_{M,n1}X_{n1}}$~~, which is obtained by multiplying an orthogonal Hadamard sequence~~ $\cancel{W_{M,n1}}$ ~~by a first set of data of~~ $\cancel{X_{n1}}$ ~~of a n-th block, and~~ $\cancel{\alpha_{n2}W_{M,n2}X_{n2}}$~~, which is obtained by multiplying an orthogonal Hadamard sequence~~ $\cancel{W_{M,n2}}$ ~~by a second set of data of~~ $\cancel{X_{n2}}$ ~~of a n-th block; complex-multiplying~~ $\cancel{\alpha_{n1}W_{M,n1}X_{n1}+j\alpha_{n2}W_{M,n2}X_{n2}}$~~, which is summed in the complex type, and~~ $\cancel{W_{M,n3}+jW_{M,n4}}$ ~~of the complex type using a complex multiplier and outputting as an in-phase information and quadrature-phase information; and summing only in-phase information outputted from a plurality of blocks and only quadrature-phase information outputted therefrom, and spreading the same using a spreading code.~~

~~Proposed Claim Amendment~~

ABSTRACT OF THE DISCLOSURE

An orthogonal complex spreading method and apparatus for multiple channels ~~and an apparatus thereof~~ are disclosed. The method includes includes the following steps: ~~of~~ complex-summing $\alpha_{n1}W_{M,n1}X_{n1}$, which is obtained by multiplying an orthogonal Hadamard sequence $W_{M,n1}$ by a first group data of X_{n1} of a n^{th} block; and $\alpha_{n2}W_{M,n2}X_{n2}$, which is obtained by multiplying an orthogonal Hadamard sequence $W_{M,n2}$ by a second group data of X_{n2} of a n-th block; complex-multiplying $\alpha_{n1}W_{M,n1}X_{n1}+j\alpha_{n2}W_{M,n2}X_{n2}$, which is summed in the complex type, and $W_{M,n3}+jW_{M,n4}$ of the complex type using a complex multiplier and outputting ~~as an~~ in-phase ~~information~~ and quadrature-phase information; ~~and~~ summing only in-phase information outputted from a plurality of blocks and only quadrature-phase information outputted therefrom; and spreading the same using a spreading code.